FINAL

FINAL STATUS SURVEY PLAN

COLONIE FUSRAP SITE

AUGUST 2002

U.S. ARMY CORPS OF ENGINEERS
NEW YORK DISTRICT OFFICE

FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM

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LIST OF ABBREVIATIONS AND ACRONYMS

AEC ....Atomic Energy Commission
ALARA............As Low As Reasonably Achievable
BRA................Baseline Risk Assessment
CISS ....Colonie Interim Storage Site
CFR ....Code of Federal Regulations
m^3 ....cubic meters
CMB................Chemical Management Building
COC ....Contaminants of concern
Conrail ....Consolidated Rail Corporation
cpm ....counts per minute
CQC ....Contractor Quality Control
CQCP ....Construction Quality Control Plan
CSXT…………..Consolidated Rail Corporation
yd^3...................cubic yards
DCGL ....Derived Concentration Guideline Level
$DCGL_{EMC}$ ....Derived Concentration Guideline Level Elevated Measurement Comparison
DNAPL……….Dense Non-Aqueous Phase Liquid
DOD ....Department of Defense
DOE ....Department of Energy
DQO ....Data Quality Objective
EE/CA............Engineering Evaluation and Cost Analysis
EPA ....Environmental Protection Agency
FID..................Flame Ionization Detector
FIDLER...........Field Instrument for Detecting Low Energy Radioactivity
FSSP..............Final Status Survey Plan
FUSRAP ....Formerly Utilized Site Remedial Action Program
GPS................Global Positioning System
HASP..............Health and Safety and Emergency Response Plan
HAZWOPER ..Hazardous Waste Operations and Response
HPGe..............High Purity Germanium
IT.....................The IT Corp, Inc
LBGR..............Lower Bound of the Gray Region
LCYD………...Loose Cubic Yard
LDR ....Land Disposal Restrictions
LNAPL ....Light Non-Aqueous Phase Liquid
MARSSIM.......Multi-Agency Radiation Survey and Site Investigation Manual
MDC ....Minimum Detectable Concentration
MDL................Minimum Detectable Level
mg/L ....milligrams per liter
Mg/Kg………..Milligrams per Kilogram
NiMo ....Niagara Mohawk Power Corp.
NL...................National Lead Industries
NRC................Nuclear Regulatory Commission
NYSDEC ....New York State Department of Environmental Conservation
ORNL ....Oak Ridge National Laboratory
OSHA ....Occupational Safety and Health Administration
PARCC...........Precision, Accuracy, Representativeness, Completeness, Comparability
PCB................Polychlorinated Biphenyl

pCi/gm............pico Curies/gram
pCi..................picoCuries
PCE................tetrachloroethene *(also known as perchloroethene)*
PID..................Photoionization Detector
PPE................Personnel Protective Equipment
QC..................Quality Control
RCRA.............Resource Conservation Recovery Act
RESRAD ....Residual Radioactivity calculation model
RPD................Relative Percent Difference
SAP ....Sampling and Analysis Plan
m^2...................square meters
SOP................Standard Operating Procedure
SPDES...........State Pollution Discharge Elimination System
TCE................trichloroethene
TCLP..............Toxicity Characteristic Leaching Procedure
TERC ....Total Environmental Restoration Contract
Th ....Thorium
U.....................Uranium
USACE...........United States Army Corps of Engineers
USEPA...........United States Environmental Protection Agency
VOC................Volatile Organic Compound
VPs.................Vicinity Properties
WAC...............Waste Acceptance Criteria
XRF ....X-Ray Fluorescence Spectroscopy
1,2-DCE 1,2-dichloroethene

1.0 INTRODUCTION

The U.S. Army Corps of Engineers (USACE) is actively remediating soil contamination at the former National Lead Industries (NL) site (herein referred to as the “Colonie Site”) and three adjacent vicinity properties (VPs), hereafter referred to as the Colonie Site. The Colonie FUSRAP Site is located in the Town of Colonie, Albany County, New York. This remedial effort falls under the USACE’s Formerly Utilized Sites Remedial Action Program (FUSRAP), which was established to identify, investigate, and clean up or control sites previously used by the Atomic Energy Commission (AEC) and its predecessor, the Manhattan Engineer District.

The IT Corp (“IT”) has assumed the ICF Kaiser Engineers, Inc. (ICF Kaiser) obligations under the USACE Total Environmental Restoration Contract (TERC) No. DACA 31-95-D-0083, Task Order No. 24/40, and is the remedial action contractor for the Colonie Site. The goal of this remedial effort is to complete the Colonie Site’s remedial objectives as described in Action Memorandum for soil removal at the Colonie Site (“Action Memorandum”) (U.S. Army Corps of Engineers, 2001). Our previously published Site Operations Work Plan (IT Corp., February 2002 or most recent version) provides a description of the remedial efforts, site history and background information.

The general site location is shown in Figure 1. The site conditions as of December 2001 are shown in Figure 2. The Site Operations Work Plan contains all necessary information relative to the site history, site background, and the site’s ongoing remedial activities. Significant documents, reports and other submittals have been made concerning the work completed over the period since mobilization in 1998. This Final Status Survey Plan (FSSP) does not include this information, as the Operations Work Plan should be consulted directly for that information.

Colonie Site remediation will be conducted in accordance with USACE’s December 2001 Final Soil Removal Action Memorandum and the supporting June 2001 Technical Memorandum. The selected remedial alternative is generally described as “Alternative 2B: large scale excavation and off-site disposal” from the 1995 Department of Energy’s (DOE) Engineering Evaluation and Cost Analysis Report (EE/CA). Radiological surveying to confirm that the residual site soils meet the radiological cleanup goals contained in the Action Memorandum will be conducted in accordance with the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) Environmental Protection Agency (EPA), Dec 1997. This FSSP details how the survey will be conducted and how the results will be evaluated. Testing requirements to determine the site’s objectives with respect to chemical contaminants of concern (COC) are contained in the Sampling and Analysis Plan (SAP) IT Corp., February 2002 or most recent version) and are not addressed in this document. Sampling for chemical contaminants of concern will be conducted concurrent with these final status survey efforts.

The Niagara Mohawk substation vicinity property has been previously released from radiological controls as of this writing and as such, it will be not considered an “affected area” for this plan. Please see USACE’s Final Draft Focused Site Investigation Report: Niagara Mohawk Power Station, Colonie NY, April 2000, as well as the New York State Department of Environmental Conservation (NYSDEC) correspondence accepting the report for details on the Niagara Mohawk site status.

2.0 HISTORICAL INFORMATION REVIEW

To support a remedial action decision, several site characterizations have been performed at the Colonie Site (excluding vicinity properties) during 1978 - 1997. A brief summary of previous efforts is presented below.

Atcor Survey (Atcor, 1978)

In 1978, Atcor conducted a radiological survey of the National Lead Industries (NL) building and equipment to assess plant operations being conducted at the time. High levels of beta-gamma radiation and external gamma radiation were found on essentially all floor areas that were surveyed.

Teledyne Isotopes Survey (Teledyne Isotopes, 1980)

The purpose of the 1980 Teledyne Isotopes survey was to determine the extent of surface soil contamination on the NL property and its vicinity resulting from stack emissions from the plant. Samples were collected from various quadrants surrounding the plant and from low-lying areas where contamination could have collected. Contamination was detected on all portions of the NL property that could be surveyed.

Teledyne Isotopes Survey (Teledyne Isotopes, 1981)

In 1981, Teledyne Isotopes conducted a second survey of the NL site to determine the extent of subsurface soil contamination. The survey identified three subsurface contaminated areas on the NL property. Daughter isotopes of Th-232 are identified in an area of the former Patroon Lake northwest of the building footprint.

Bechtel National Inc (BNI) Geological and Hydrogeological Investigation (1984)

This investigation consisted of stratigraphic characterization, field permeability tests and geotechnical analysis. Five stratigraphic units and the two groundwater systems were identified. The tests also set hydraulic conductivity values and established primary hydrogeologic characteristics such as groundwater flow direction and gradients.

Oak Ridge National Laboratory Survey (ORNL, 1988)

The ORNL survey determined that some radiological measurements of the adjacent Conrail property were in excess of Department of Energy's original cleanup criteria.

Characterization Report for the Colonie Site (BNI, 1992)

The Characterization Report summarized existing data from previous investigation efforts. The information presented in the Characterization Report was used in developing the Engineering Evaluation and Cost Analysis (EE/CA) alternatives.

Engineering Evaluation and Cost Analysis (DOE, 1995)

An EE/CA was performed to identify, develop, and evaluate remedial action alternatives for the site, based on the nature and extent of contamination documented in the remedial investigation report. The report also evaluated the potential environmental consequences of the various remedial action alternatives identified. Seven alternatives were evaluated, ranging from no action to complete excavation with offsite disposal. This document established the initial site residual contaminant guidelines for U-238 at 35 pi/gm and Th-232 at 15 pCi/gm. Additionally, this document allowed for the on-site internment of soils contaminated with U-238 between 35-100 pCi/gm.

Employee Exposure Risk Assessment (BNI, 1997)

A baseline risk assessment (BRA) was conducted which presented the findings of an assessment to determine the human health and ecological risks posed by the presence of radioactive and associated chemical contamination. The BRA concluded that radioactive and chemical contaminants at the Colonie Site could result in risks to human health and ecological resources. Major potential human radiation exposure pathways identified were direct external radiation and inhalation of particulates.

Action Memorandum for Soils Removal at Colonie Site and Supporting Technical Memorandum, (USACE, 2001)

Radiological and chemical risk assessments were conducted to support the decision making process for the Action Memorandum at the Colonie Site. These documents concluded that radioactive and chemical contaminants at the Colonie Site resulted in unacceptable risks to human health. Further, the document lowered the residual Th-232 contaminant concentration to 2.8 pCi/gm in excess of background. The U-238 concentration remained at 35 pCi/gm in excess of background and the allowance for on-site internment was removed.

3.0 FINAL STATUS SURVEY DESIGN

The final status survey design process begins with development of data quality objectives (DQOs). The DQOs are then used in conjunction with the radiological conditions at the site to calculate the number and locations of measurement and sampling points to demonstrate compliance with the release criterion. Survey techniques and analytical methodologies are selected to generate the required analytical data. Once the analytical data is received from the laboratory and validated, it is evaluated using statistical techniques to test against the hypothesis stated in section 3.1.2. Sampling, as discussed in this and subsequent sections, refers to the collection of information. "Sampling" includes scanning surfaces with radiological and X-Ray fluorescence equipment as well as the physical collection of media for on-site and off-site laboratory analysis.

3.1 DATA QUALITY OBJECTIVES

DQOs for the Colonie Site were developed in accordance with "Guidance for Planning for Data Collection in Support of Environmental Decision Making Using the Data Quality Objectives Process" (USEPA, 1994a), as directed by MARSSIM (USEPA, 1997). The following steps were used in the development of DQOs for the site.

3.1.1 Problem to be Resolved

The selected remedial alternative in the Action Memorandum for implementation at the Colonie Site includes excavation and offsite disposal of soils that contain (1) U-238 activity greater than 35 pCi/gm in excess of background and/or (2) Th-232 activity greater than 2.8 pCi/gm in excess of background. Demonstrating that chemical contaminants meet cleanup values in the Action Memorandum will be addressed in the individual FSS Unit Reports.

3.1.2 Decision to be Made

Following remediation of a given survey unit or area of the site, it must be determined if the site-specific cleanup guideline has been met, or if further remediation is warranted. Therefore, the decision to be made can be stated: "Do the Final Status Survey Unit soils contain less than 35 pCi/gm in excess of background U-238 AND contain less than 2.8 pCi/gm in excess of background Th-232." The null hypothesis (H_o) as required by MARSSIM is stated and tested in the negative form: "The median concentration in the survey unit exceeds that in the reference area by more than the $DCGL_W$."

3.1.3 Inputs to the Decision

Inputs to the decision include the type, quality, and quantity of data that will be sufficient to make decisions. The type refers to the radiological data needed for the survey unit soils. Quality refers to various aspects of the analytical data collected such as precision, accuracy, representativeness, comparability, and completeness (PARCC), required and achieved detection limits, and data validation documentation requirements. Validation that the resulting data meets the agreed-to PARCC values will ensure the 'quality' of the information and allow the results to be used in testing the site cleanup hypothesis. Quantity refers to the amount of data necessary to confirm compliance with the release criteria, and is determined as part of the design process. Data quality requirements are provided below.

3.1.3.1 Precision

Precision refers to the level of agreement among repeated measurements of the same parameter. The overall precision of a piece of data is a mixture of sampling and analytical factors. The analytical precision is much easier to control and quantify because the laboratory is a controlled, and therefore measurable environment. Sampling precision is unique to each site, making it much harder to control and quantify.

As described in Section 3.7, each physical soil sample obtained from an individual field survey unit is also subjected to a static count prior to obtaining the soil sample. Field instrument sampling precision will be checked by obtaining a minimum of ten replicate static measurements for every survey unit. Precision will be evaluated by calculating the relative percent difference (RPD) for each replicate pair. It is expected that the field instrument replicate pairs will generally have RPDs $\pm 2\delta$ %.

Laboratory sampling precision will be checked by obtaining a minimum of one replicate sample for every 20 physical soil samples collected in a given survey unit. Precision will be evaluated by calculating the RPD for each replicate pair. It is expected that the soil field replicate pairs will generally have RPDs $\leq$50%.

Laboratory precision will be evaluated by following the procedures outlined in the Sampling and Analysis Plan: Quality Control and Quality Assurance Sections. This generally involves the minimum analysis of one replicate sample or recount of previously sampled location for every sample batch. A sample batch is defined as a group of samples which behave similarly with respect to the sampling or testing procedures being employed. For quality control (QC) purposes, a group of twenty samples of similar physical media collected within one work week, or all such samples collected in a work week (if less than twenty), whichever occurs first, is considered a ‘batch’. The RPD for each analytical parameter will be calculated and compared to a method-specific precision criteria derived from historical performance data. If these criteria are not met, a careful examination of the sampling techniques, sample media, and analytical procedure will be conducted to identify the cause of the high RPD and define the usability of the data.

3.1.3.2 Accuracy

Accuracy refers to the difference between a measured value for a parameter and the true value for the parameter. It is an indicator of the bias in the measurement system. Field instrument accuracy will be evaluated by comparing the static count measurement at each soil sample location with the laboratory result. The accuracy should be consistent with those from the correlation data. Laboratory accuracy will be evaluated by the analysis of one method blank per sample batch and one spiked sample per sample batch as applicable for radionuclides - see the Sampling and Analysis Plan for further details of the lab QC requirements. The accuracy of all analyses must be within historically derived, method-specific criteria.

3.1.3.3 Representativeness

Representativeness is a measure of the degree to which the measured results accurately reflect the medium being sampled and the overall situation at the site. It is a qualitative parameter which is addressed through the proper design of the sampling program in terms of sample location, number of samples, and actual material collected as a sample of the whole.

The final status survey unit sampling program has been designed in accordance with the guidance given in MARSSIM (USEPA, 1997), to ensure that the appropriate statistically derived number of samples are collected during final status surveys. Sampling protocols discussed in the SAP have been developed to assure that samples collected are representative of the media. Field handling protocols (e.g., storage, handling in the field, and shipping) have been designed to preserve the integrity of the collected samples. Proper field documentation and QC efforts outlined in the Contractor's Quality Control Plan (IT Corp, 2000 or most current version) will be used to establish that protocols have been followed and that sample identification and integrity have been maintained.

3.1.3.4 Comparability

Comparability expresses the confidence with which one data set can be compared to another. When comparing data, it is important to compare data collected under the same set of conditions. Seasonal trends, depth of sample collection, analytical protocol, method detection limits, and any other sampling/analytical variables must be taken into account when comparing data sets. This is accomplished via the SAP using established USACE methods for collecting the samples, using USEPA methods for chemical analyses, using other published and documented methods for physical and radiological analyses, and documenting the methods used.

3.1.3.5 Completeness

Completeness is a measure of the amount of information that must be collected during the final status survey to allow for successful achievement of the project objectives. The overall objective of the remediation at the site is to remove contaminants exceeding the cleanup criteria presented in USACE's Final Action Memorandum and supporting Technical Memorandum.

A certain amount and type of data must be collected for each final status survey unit to be valid. The statistically-derived number of samples has been calculated in accordance with MARSSIM (USEPA, 1997). Missing data may reduce the precision of estimates or introduce bias, thus lowering the confidence level of the conclusions. The completeness goal for each final status survey will be 95% (areal) for the field sampling and 95% (number) for the laboratory analyses. The importance of any lost or suspect data will be evaluated in terms of the sample location, analytical parameter, nature of the problem, decision to be made, and the consequence of an erroneous decision. Critical locations or parameters for which data are determined to be inadequate may be resampled.

3.1.3.6 Sensitivity

Sensitivity refers to the ability to detect a minimal amount of a substance, and is typically expressed as the method detection limit, practical quantitation limit, or reporting limit. Radiological analyses must indicate if the soil remaining at the site has met the cleanup criteria. Therefore, the required off-site analytical laboratory minimum detectable level (MDL) has been set at 1 pCi/gm of U-238 and 1 pCi/gm of Th-232. Field instrument scan minimum detectable concentration (MDC) has been set to 9 pCi/gm for U-238 and 1.8 pCi/gm for Th-232. The scan MDC calculation is provided in Appendix D.

The correlation between gamma radiation to soil activity levels is based on an historical correlation study conducted by TMI on behalf of the Department of Energy in 1993 and is supplemented by studies conducted by The IT Corp and Argonne National Laboratory (ANL). These correlation studies will continue to be supplemented with data from the FSS Units.

3.1.4 Boundaries of the Study

Spatial boundaries of the decision statement are limited to the radiological contaminants within the residual on-site soils following remediation. Collected data will represent current radiological site conditions as well as radiological site conditions as they are expected to exist over the next 1,000 years, including normal radioactive decay products.

3.1.5 Decision Rules

If the concentration of residual U-238 and Th-232 radioactivity in the soils of a given survey unit is below 35 pCi/gm in excess of background and 2.8 pCi/gm in excess of background respectively, the survey unit is clearly in full compliance with the release criterion. The MARSSIM process specifically includes the use of elevated measurements as a component of radiation surveys and site investigations. Elevated areas should be rare as remediation activities are being rigorously conducted. “Hot spot criteria” will be a multiple of the clean-up criteria.

Any such "hot spots" identified (if any) during the gamma scanning cross-walk of the final excavation surface will be plotted on survey unit maps. All survey unit maps will be evaluated to identify areas which may require additional evaluation based on spatial distribution of the elevated measurements. Any elevated areas will be evaluated following the criteria in Section 3.7: Elevated Measurement Comparison.

The fact that the Colonie Site manufactured lead and lead based products long before radioactive materials or components were introduced is generally accepted in the site history and characterizations. Accordingly, the radiological contamination is expected to be completely removed before the Action Memorandum specified metals clean-up goals are achieved. See the Site Operations Work Plan for a detailed discussion of the excavation efforts in support of the removal and sampling for chemically contaminated soils that are generally being encountered below the applicable site radiological criteria.

The correlation between daughter gamma radiation to soil activity levels is based on an historical correlation study conducted by TMI on behalf of the Department of Energy in 1993 and is supplemented by a study conducted by The IT Corp in 1999. These correlation studies will be supplemented with data from the FSS Units. Copies of both the TMI study and The IT Corp’s correlation efforts are included in Appendix A.

3.1.6 Acceptable Decision Errors

DQO guidance indicates that the worst-case scenario should be assumed as the null hypothesis; the data is then required to prove that the worst-case scenario does not exist. The null hypothesis can be stated thus: “The median concentration in the survey unit exceeds that in the reference area by more than the $DCGL_W$”. It is then incumbent on the data to show otherwise.

Site measurement data are used to estimate the actual site conditions and decisions based on the measurement data could be in error (known as decision error). Statistical sampling designs in accordance with MARSSIMS attempts to control design error by defining the types of errors and incorporating them in the statistical sampling design process.

The possible types of decision errors include:

- Type I errors (α): Concluding that residual radiological contamination does not exceed the cleanup criteria when it actually exceeds the criteria.

- Type II errors (β): Concluding that residual radiological contamination exceeds the cleanup criteria when it actually is below the criteria.

Type I and Type II errors have distinctly separate consequences. Type I errors have human health consequences (the residual radiological risk at the Colonie Site could lead to excess human health problems), political consequences (local, state, and federal officials may face undue pressure if it is discovered that the site may not have been adequately cleaned up), and cost consequences (the cost of excavating selected portions of the site after remediation is complete would be significant).

Type II errors do not have residual risks but rather have cost and resource consequences (the manpower, equipment, and disposal costs associated with excavating and disposing of material that already meets the cleanup criteria is an unnecessary expense).

Several different scenarios were then evaluated for Type I and Type II errors. Based on the discussions above, Type I errors are the more significant errors due to human health and political consequences. The NYSDEC has determined that a Type I error value of no greater than 0.025 would be acceptable. The USACE project team has advised that based on the probability that lead-containing soils requiring remediation are likely to exist at depths below the anticipated levels of radiological contamination, a Type II error value of 0.1 was acceptable.

3.1.7 Sampling Design

Information presented in the previous characterization documents indicated the concentrations of U-238 and Th-232 in background measurements were low compared to the cleanup criteria, however; the Technical Memorandum and Action Memorandum has lowered the Thorium cleanup criteria to 2.8 pCi/g from 15 pCi/g, close to background. Therefore, MARSSIMS Manual Table 5.3 “Contaminant is Present in Background” was used to determine the number of final status survey samples needed in each survey unit.

The derived concentration guideline level (DCGL) is defined in MARSSIM as a radionuclide-specific concentration that could result in a member of the public dose at the allowed limit or meeting a specific allowed risk. For the Colonie Site, the DCGL is defined in the Action Memorandum as 35 pCi/gm in excess of background for U-238 and 2.8 pCi/gm in excess of background for Th-232. The lower bound of the gray region (LBGR) has been initially selected as half of the action levels. Therefore the delta-value, Δ, for the U-238 is 17.5 and for Th-232 is 1.4. The MARSSIM DQO process requires a subsequent review of the selected LBGR value as survey unit data becomes available.

Current site data representing seventy (70) individual soil samples/sample locations was used to determine the standard deviation for U-238 and Th-232 analyses of site soils. Table 1 shows the site data used to calculate the standard deviation. This data is a combination of samples from initial FSS efforts in 2000 and the more recent work associated with the time sensitive replacement of the stormwater culvert that transects the site. Table 2 presents the statistical information for the data in Table 1. The standard deviations were determined to be 5.35 for U-238 and 0.25 for Th-232. As the post-excavation surfaces will likely contain some low level of residual activity, the distance between the DCGL and the LBGR was selected as the initial best estimate. This is a conservative assumption since the lead cleanup criteria is generally resulting in a deeper and larger excavation than would be required solely for radiological contaminants of concern.

The delta over sigma value for U-238 is 3.3 (17.5/5.35) and for Th-232 the value is 5.6 (1.4/0.25). Since the calculated delta over sigma value for Th-232 exceed the highest value contained in Table 5.3 of the MARSSIMs Manual, the maximum value of 4 is utilized. MARSSIMS Manual Table 5.3 yields a total of 9 samples (N/2) required from each final status survey unit (FSSU) for U-238 and for Th-232 to satisfy the MARSSIM process and 9 samples are required in the reference area. Based on requirements of the NYSDEC with respect to sampling for chemical COCs, the actual number of samples obtained from a survey unit will be rounded upwards to the nearest whole number divisible by three, i.e. 8 samples would actually result in a minimum of 9 samples being obtained. In this case, the 9 samples are divisible by three and no rounding is required. The predicted measurement error will be reevaluated based on the sampling results as the MARSSIM process proceeds through the FSS process and through continued use of the Wilcoxon Rank Sum Test for evaluating DCGL compliance.

3.2 SURVEY UNIT LAYOUT

3.2.1 Classification

MARSSIM (USEPA, 1997) defines three classes of survey units: 1, 2, and 3. The Colonie Site has only Class 1 areas based on the Characterization Report. Class 1 MARSSIMS units are areas that have, or had prior to remediation, a potential for radioactive contamination or known contamination that exceed the DCGLs. Examples include site areas subjected to remediation, leak or spill locations, and former burial or disposal areas. Class 1 areas can be up to 2,000 sq. meters in area.

All areas within the site boundaries will be considered “affected” and Class 1. All Colonie FUSRAP Site Final Status Survey Units will be as close as feasible to 1,999 square meters in size. Smaller units and/or oddly shaped units may be required due to limitations associated with the site physical conditions, infrastructure, and property lines.

3.2.2 Delineation

As each successive unit is defined in the field, based on various physical and scheduling parameters, the individual unit will be subjected to civil surveying effort and a FSS Unit map produced. Each successive FSS Unit map will be added to previous FSS Unit mapping efforts to provide a site wide updated final status survey map. Figures 3 and 4 provide examples of the FSS Unit location and topographic survey/sample location maps that will be prepared for each Survey Unit. IT Corp will follow the same general concept of survey area lay-out such as minimum dimensions and surface area per unit for all Final Status Survey Units designated. However, each individual area will be defined as the work progresses based on physical site constraints, such as power poles and drainage culverts.

All areas of the site will eventually be subjected to a final status survey. As each unit is laid-out, the area lay-out/survey unit dimensions will be shown in an updated final status survey figure. In general, the use of triangular sample grids, as recommended in MARSSIM, will be followed. However, exceptions will be allowed to work around specific site physical constraints.

3.3 PHYSICAL SAMPLE LOCATIONS

The physical sample locations within each survey unit will be laid out using a triangular grid. The distance between survey locations (L) will be determined as detailed in MARSSIM section 5.5.2.5, knowing the actual area of the survey unit and the number of samples. The distance between rows of survey points will be calculated. For example, with a 2,000 sq. meter area and 9 samples, the distance will be the square root of the product of the area divided by 0.866 times the number of samples. The layout of the final status survey sample locations will be determined utilizing a random starting point as per MARSSIM, and laid out in a triangular pattern with each sample location being “L” distance away from the previous location. Therefore, the exact sample locations will be dependent on the random starting locations. If the location of the 9 samples do not all fall within the boundaries of a sampling unit then additional randomly selected locations within the sample unit will be determined such that 9 samples are collected within each survey unit. Appendix B contains an example calculation showing how FSS samples are located per MARSSIMS section 5.5.2.5.

3.4 FIELD INSTRUMENT SURVEY METHODOLOGY

Following excavation from a particular survey unit, a field scan of the survey unit will be conducted using a thin window low energy X-Ray detector - thin window Field Instrument for Detecting Low Energy Radioactivity (FIDLER). If the field scan indicates selected areas with elevated radioactivity (> DCGL), those areas will be further excavated and the resulting fresh surface soil field scanned. Details are provided below.

Field Scanning:

Surface soil scans will provide 100% coverage of the survey units. This is accomplished using a cross-walk approach where the survey unit is walked in a north-south direction followed by a complete walk in the east-west direction. This process minimizes the probability of an area of significant size being missed in the cross-walk survey. Additional biased field scanning will be conducted in other areas if deemed appropriate.

Field scanning will be performed using a FIDLER gamma scintillation detector with a single channel scaler/rate meter. The FIDLER shall be combined with a Global Positioning System (GPS) and a data logging instrument which marries the FIDLER reading with the GPS position data every two (2) seconds. Appendix B contains an example of the field survey data in table form that will be generated for each FSS field survey. This particular data is associated with a cross-walk conducted between Culvert Stations 1+00 and Station 1+50 during the culvert replacement work.

The resultant radiological walkover data and GPS location data will be downloaded into the ArcView plotting program to provide a graphic description of the cross-walk survey efforts. Figure 5 is an example of a representative cross-walk data plot and shows that all FIDLER readings are below the conservative correlation value of 13,001 cpm (green dots). Readings between 13, 001 and 33,400 cpm are yellow dots (indicating levels greater than 35 pCi/gm in excess of background and less than 167 pCi/gm) and readings over 33,401 cpm are plotted in red (indicating levels greater than 167 pCi/gm). These levels correspond directly with limits on the various waste disposal sites currently authorized by USACE for disposal of Colonie materials. For additional information and details on the correlation studies please see Appendix A.

The walkover data and the data plots will be evaluated by IT Corp staff and presented to the USACE staff in accordance with the USACE CQC plan for the site.

Based on these evaluations the following activities will occur:

> The data is deemed acceptable and physical sampling for off-site analytical will be conducted; or
>
> The data indicates small areas of elevated activity less than the “hot spot” criteria in magnitude; or
>
> The data indicate elevated measurements/hotspots above the specified levels and additional excavation is required. The survey unit requires additional remediation.

Sample Collection:

Surface soils samples will be collected at the specified 9 locations in each respective survey unit. Each FSS sampling event will be discussed and scheduled in advance of the actual sampling at the weekly project progress meeting to allow USACE and/or others to make necessary arrangements to observe and/or to identify the desire for spilt samples. At each physical sample location, a field scan using the appropriate field instrument (FIDLER, 2 by 2 or both) will be performed immediately prior to sample collection so that the current correlation between field scans and laboratory analytical data can be updated. This field scan will consist of a one (1) minute duration count reading at each of the 9 physical soil sample locations.

Samples will generally be described as right circular cones of approximately 6 inch diameter by 6 inch deep plug from each location. Samples will be placed in a clean aluminum tray and homogenized to the extent practicable. Once the sample has been mixed, an approximate 500 gram sample will be collected. Each sample will be identified with a unique sample ID number in accordance with IT’s Sampling and Analysis Plan (SAP, February 2002 or most recent version). Full details on sample numbering, documentation, custody, and shipping can be found in the SAP. Quality control measures associated with FSSP efforts are conducted as described in the IT Corp’s revised Contractor Quality Control Plan (CQCP, February 2002 or most recent version).

3.5 SAMPLE ANALYSES

The final status survey soil samples will be subjected to a series of analyses. In-situ field tests will be obtained at each sample location prior to sample acquisition. A one minute static count using the FIDLER will be obtained and compared to the most recent correlation between field readings and radioactivity. A second in-situ field analysis will be obtained for inorganic contaminants of concern using the Niton field X-Ray fluorescence instrument. Procedures for obtaining field X-Ray Fluorescence Spectroscopy (XRF) data are detailed in the Site Operations Plan (February 2002 or most recent version). The soil samples are then physically collected as noted above and as per the procedures detailed in the Sampling and Analysis Plan. All FSS samples will be analyzed for radioactive contaminants of concern using the on-site High Purity Germanium (HPGe) detector.

The final confirmatory analysis will be completed by shipping the samples to a USACE certified laboratory. The off-site analysis will provide confirmation of radiological concentrations via alpha spectroscopy for both Isotopic Uranium and Thorium. The laboratory will report the isotope(s) detected, minimum detectable activity, measurement error and detected activity (in pCi/gm) at a minimum. Additional off-site analysis will be completed for total metals to provide confirmation of total lead, total copper and total arsenic levels in the samples. Where appropriate, TCL volatile analysis will also be conducted per the site Operations Work Plan and the Sampling and Analysis Plan. Each of the FSS samples will be archived on-site for future use as USACE sees fit.

3.6 QA/QC

Over-all quality control will be provided as described in the Contractor's Quality Control Plan (February 2002 or most recent version) governing site operations. Analytical laboratories will follow the QC requirements specified in the SAP. QA/QC for on-site analysis will be provided via daily pre and post instrument calibration efforts. In addition, replicate, matrix spike, and matrix spike duplicate samples will be collected as described in the SAP at a rate of one per 20 samples. A minimum of one blind replicate sample will be analyzed from each survey unit. USACE's quality assurance laboratory will also receive a minimum of one split sample from each survey unit. Additional split samples will be obtained as directed at the time of sampling based on USACE's direction. All of IT's replicates will be analyzed by the off-site analytical lab for the same radiological parameters as the primary survey samples.

3.7 DATA INTERPRETATION

Interpretation of the analytical data will be conducted per IT Corp's SAP and QAPP as well as in accordance with MARSSIM Chapter 8. The following methods will be employed, although the data itself may indicate that alternate tests are more appropriate. The reader is directed to the SAP for a full and complete discussion of the data quality reviews that will occur in advance of any data assessment with respect to radiological clean-up criteria.

Data Assessment: The first step in the assessment will be data verification to verify that field work was conducted as planned. A review of all field documentation will be conducted to determine if the correct sampling methods were performed, instrumentation and equipment operated properly, deviations from the planned methods were documented, and the deviations will result in data that meets the objectives of the sampling.

Preliminary Data Review: All of the values will be compared with the DCGL. If all values from one survey unit are below the DCGL, the survey unit has clearly met the cleanup criteria. If all values from a survey unit are above the DCGL, the survey unit has clearly not met the cleanup criteria.

Assuming a range of values bracketing the DCGL are obtained from a survey unit, the mean, standard deviation, and median will be calculated for the data from each survey unit. The following checks will be performed:

- If the mean > DCGL, the survey unit has not met the cleanup criteria.
- The standard deviation will be compared to that used during sample design to ensure that an adequate number of samples were collected.
- The mean will be compared with the median. If there appear to be large differences, the skewness of the data set will be further examined.

- The data may be displayed on a map of each individual survey unit (posting plot). The display may indicate one or more areas of the survey unit that are above the DCGL.
- The laboratory data will be plotted with a quartile plot or histogram to examine the potential for outliers or trends in data.
- The laboratory data set will be tested using the Wilcoxon Rank Sum test as described in MARSSIM to determine if a survey unit can be considered clean.

Elevated Measurement Comparison: If required for data assessment purposes, the Derived Concentration Guideline Level for Elevated Measurement Comparison (DCGLEMC) will be calculated in one of the following manners:

Elevated measurements will not exceed the DCGLEMC = (area factor) x (DCGL) with the appropriate area factor from the RESRAD run.

The area factor is the magnitude by which the concentration within a small area of elevated activity can exceed the DCGL while maintaining compliance with the release criteria. Outdoor area factors were calculated using the Residual Radioactivity Calculation Method (RESRAD) 5.82 (USDOE, 1993). The RESRAD model outputs are included in Appendix C. All exposure pathways were calculated assuming a concentration of 35 pCi/g U-238 and 2.8 pCi/g Th-232. The area of contamination was set at 2000 m2, which set the area factor equal to one. Area factors for the other sizes were determined by utilizing all RESRAD defaults and changing only the area of the contamination zone. The area factor was then computed by taking the ratio of the dose per unit concentration generated by RESRAD (2000 m2) to that generated for the other areas listed. These area factors are listed as follows:

Area Factors for U-238 and Th-232 As Applicable to the Colonie Site

Area Factors for U-238 and Th-232 at the DCGL Value									
Area: (m2)	1	5	10	50	100	500	1000	1500	2000
Area Factor	23.46	7.92	5.28	3.29	2.87	1.65	1.12	1.01	1.00

Each measurement from the survey unit will be compared with the DCGL. Values above the DCGL will be further investigated and compared to the $DCGL_{EMC}$, as appropriate. The actual size of the affected area will be determined by returning to the suspect sample point and using the FIDLER detector to define the elevated measurement boundary. The area factor can then be determined based on the actual area, the $DCGL_{EMC}$ calculated, and the comparison made between the measured activity level and the $DCGL_{EMC}$.

For example, if field scanning determines an actual area of 100 m^2 with elevated activity, the combined area factor would be 2.87 and the $DCGL_{EMC}$ would be 100.5 pCi/g U-238 (2.87 x 35) and 8.0 pCi/g Th-232 (2.87 x 2.8). If the elevated area sample concentrations exceed the $DCGL_{EMC}$, it requires further investigation and remediation as appropriate. If the concentrations are less than the $DCGL_{EMC}$, then the Wilcoxon Rank Sum Test will be used to determine if the total number of elevated areas within a survey unit are within the statistical allowance of the test. Survey units passing this test will not require additional excavation, however; if it fails this test then further remediation is required, followed by resampling of the re-excavated areas. The Wilcoxon Rank Sum Test is performed as outlined in the following six steps by MARSSIM:

Step 1

Obtain the adjusted reference area measurements, Zi, by adding the DCGLW to each reference area measurement, Xi. Zi = Xi + DCGLW.

Step 2

The m adjusted reference measurements, ZI, from the reference area and the n measurements, YI, from the survey unit are pooled and ranked in order of increasing size from 1 to N, where N = m + n.

Step 3

If several measurements are tied (i.e., have the same value), they are all assigned the average rank of that group of tied measurements.

Step 4

If there are t less than (<) the decision level (L_c) values, they are all given the average of the ranks from 1 to t. Therefore, they are all assigned the rank $t(t+1)/2t = (t+1)/2$, which is the average of the first t integers. If there is more than one detection limit, all observations below the largest detection limit should be treated as < values.

Step 5

Sum the ranks of the adjusted measurements from the reference area, Wr. Note that since the sum of the first N integers is N(N+1)/2, one can equivalently sum the ranks of the measurements from the survey unit, Ws, and compute Wr = N(N+1)/2 - Ws.

Step 6

Compare Wr with the critical value given in MARSSIM Table I.4, Critical Values for the WRS Test, for the appropriate values of n and m. If Wr is greater than the tabulated value, reject the Null Hypothesis that the survey unit exceeds the release criterion.

Draw Conclusions: Possible conclusions which can be drawn during data interpretation are as follows:

1. The sum of the reference area ranks is greater than the critical value (the null hypothesis is rejected) and the survey unit has met the release criteria.

2. The sum of the reference area ranks is less than the critical value and the survey unit has not met the cleanup criteria. Additional remediation is required, followed by a new final status survey.

Prepare Report: Results of each successive final status surveys will be compiled into separate Final Status Survey Reports for the individual unit. These reports will detail the survey unit location and physical dimension/size, cross-walk field scan data maps, field scan data files, physical sampling locations, in-situ field data, on-site analytical data, off-site analytical data, data assessment, data validation, data review, statistical tests performed, and conclusions drawn from each survey unit. Each successive FSS unit map will be added to the previous FSS unit mapping to maintain a global perspective on the progress of the final status surveying efforts. This base map will also include any other relevant updates to the site conditions based on other remedial activities.

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